THE AUDIO LEAGUE REPORT

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RECORD EQUALIZATION

Few aspects of hi-fi reproduction are as confused as the problem of record equalization. Basically a simple concept, it has been complicated in the past by the lack of industry standardization. The current trend is toward the use of an industry-wide recording characteristic which should, within a very few years, enable a welcome reduction in the number of controls needed in a hi-fi system.

All modern recording curves are essentially the same, differing only in the details of their inflection points and the amounts of equalization employed. The basic problem is a result of the use of magnetic cutting heads in making the master disc. Magnetic cutters are constant velocity devices. This means that with a constant signal voltage applied, the amplitude of the cutting stylus motion will increase as the frequency is lowered, at the rate of 6 db/octave (going down one octave will double the recorded amplitude). It is easy to picture the problems which would arise if it were desired to record the lowest frequencies of music. Actually, the cutter amplitude would be so large that severe distortion would be generated in the cutter itself, possibly resulting in its destruction. In adtion, it would be necessary to use such wide groove spacing to avoid over-cutting that the record's playing time would be severely limited.

The solution to the problem consists of reducing the electrical signal fed to the cutter at a 6 db/octave rate, starting at some frequency usually in the vicinity of 500 cycles. As a result, signals below the "turnover frequency", as it is called, are recorded with constant amplitude. The design of the cutter, the groove pitch, the dynamic range of the recorded material, and the turnover frequency are all inter-related to a greater or lesser extent.

Pre-war 78 RPM records were generally equalized in just this fashion when recorded, with the highs recorded "flat" (constant velocity). Since a magnetic pickup responds to its stylus motion in the same manner as a recording stylus responds to its exciting signal, a constant velocity recording will generate a constant output voltage in a magnetic pickup cartridge. All frequencies above the turnover frequency will therefore be played back flat, just as they were recorded. (We are, of course, describing an idealized recording and playback process in which no resonances or other distorting factors exist).

As we go below the turnover frequency, the output of the pickup will fall at 6 db/octave, just as the original recording signal was reduced at the cutter. In order to obtain a flat output, the playback preamplifier must have a bass boost introduced at a 6 db/octave rate starting at the turnover frequency. This boost must be continued down to the lowest frequency it is desired to reproduce, unless the recording curve has been modified in some manner, e.g. Columbia LP curve.

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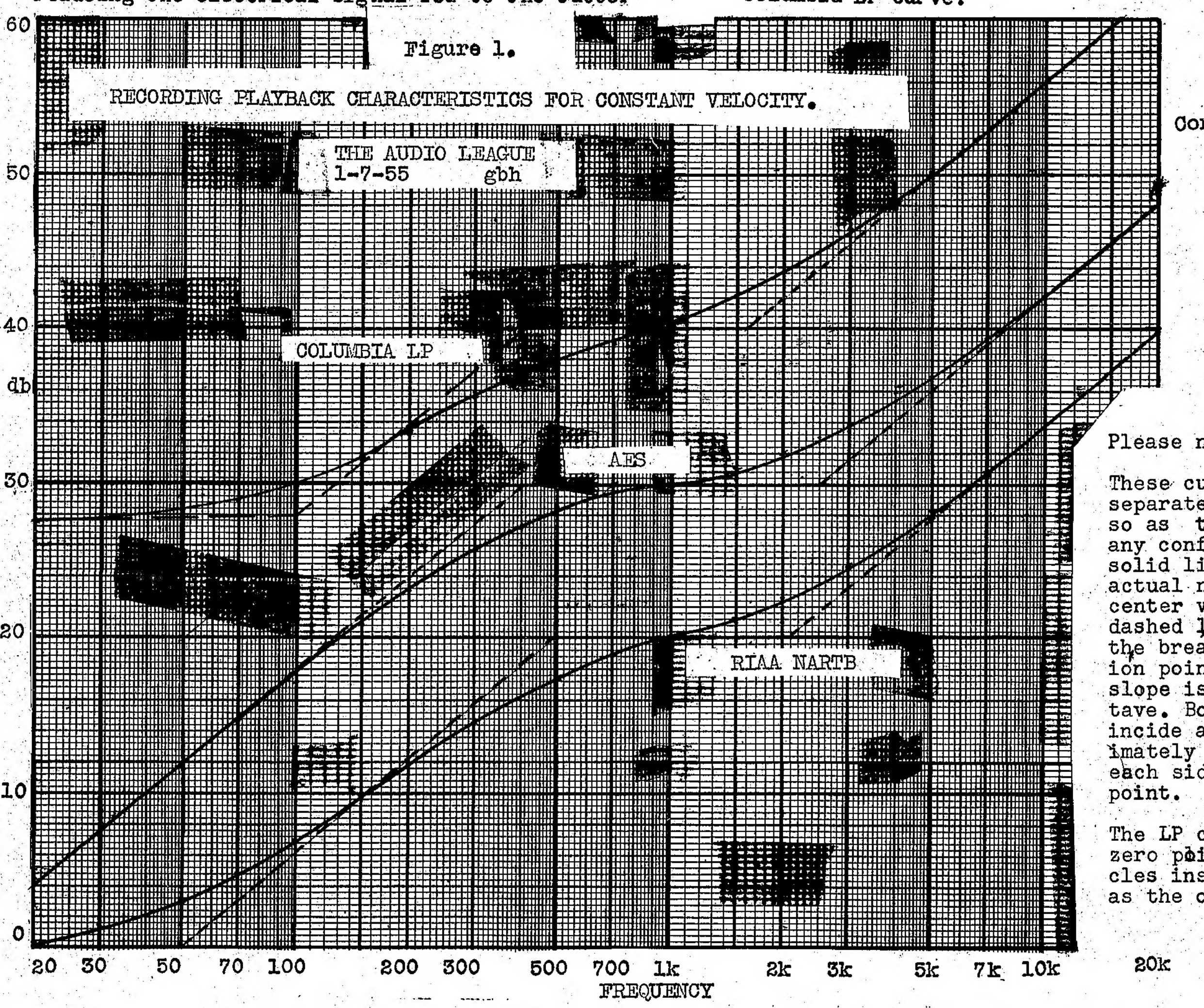

Please note:

These curves are separated by 10 db so as to prevent any confusion. The solid lines are the actual nominal or center value. The dashed lines connect the break or inflection points. Their slope is 6 db per octave. Both curves coincide after approximately two octaves each side of the break point.

The LP curve has a zero point at 900 cycles instead of 1 kc as the other two have.

Record Equalization Cont. from pg. 1.

High frequency equalization came about as a result of the search for improved signal/noise ratios. The familiar record scratch approximates what is known as "white noise". This means that the noise energy per cycle of bandwidth is constant over the entire audio spectrum. Since the high frequency portion of the spectrum contains most of the cycles, it also contains most of the noise. Reduction of this noise is accomplished by boosting or "pre-emphasizing" frequencies above a certain frequency in the recording process, almost always at a 6 db/octave rate. To reproduce this properly, the playback preamplifier reduces high frequencies at 6 db/octave above the so-called "roll-off frequency". The reproduced signal then exactly corresponds with the original signal. However, the noise content of the higher frequencies is substantially reduced due to the reduction of high frequency response in the preamplifier.

The portions of the frequency spectrum which are pre-emphasized at a 6 db/octave rate are actually recorded with constant amplitude, instead of the usual constant velocity characteristic. If the turnover and roll-off frequencies are not too far apart, the result is that the entire audio spectrum is recorded with approximately constant amplitude. This fact has led to the introduction of high quality constant amplitude pickups(Weathers capacitance type, Pfanstiehl strain gage type, and several high quality, ceramic and crystal, cartridges) as opposed to the constant velocity magnetic cartridges (GE, Pickering,Audak, Fairchild, ESL, etc) ,which have dominated the field for some time. It was argued that since a velocity responsive pickup had to be heavily equalized to properly reproduce a modern record, why not use an amplitude responsive pickup in the first place and do away with all this equalization, or at least a large part of it?

We are not going into the pros and cons of this question at this time, except to say that, as the acceptance of a single recording characteristic by the entire industry becomes a fact, the arguments of the constant amplitude pickup manufacturers will have more and more validity.

There is also a problem of low frequency noise, comprising hum and rumble. Due to the need for low frequency boost in equalizing magnetic cartridges , any hum in the recorder which may be picked up by the cartridge or the preamplifier input will be greatly exaggerated. Since hum is predominantly 60 or 120 cycles, little, in terms of equalization can be done to correct this situation except to prevent its being picked up in the first place.

Rumble is a more difficult problem. It is caused by mechanical vibration of the turntable and/or arm relative to each other, induced by motor vibration, idler wheel defects, or improper machining of the turntable. This is evidenced by an electrical output from the pickup at the rumble frequency or frequencies.

In general, all three components will be present. In a turntable driven at 33½ RPM by a 4-pole motor revolving at slightly under 1800 RPM, the most audible component is usually around 30 cycles, the motor frequency. Turntable eccentricities will introduce a ½ cycle component, usually too low to pass through an audio system, and easily filtered out in any case without loss of desired signals. There will also be idler noise at some frequency between these two, depending on t the size of the idler wheel. Usually it will be of the order of 5-10 cycles. This component is best eliminated by a sharp cut-off high pass filter at 15-20 cycles.

That 30 cps motor frequency component is the real bug-a-boo, however. To equalize the AES characteristic, for example, requires some 22 db of boost at 30 cycles. Any 30 cycle rumble will be amplified 22 db or about 12 times. If one wished to equalize down to 16 cycles, for some of Emory Cook's organ records,28 db of boost would be needed at that frequency. Any idler components or their harmonics in that region would be amplified 25 times, with usually disastrous results. Apart from mechanical problems, large amounts of low frequency equalization require additional stages of gain in an amplifier, with attendant complexity and cost increase.

In recognition of this problem, Columbia employed a special characteristic on their LP records when they were introduced in 1948. Instead of continuing the reduction of low frequency response indefinitely, they introduced a boost starting at 100 cycles. This had the effect of leveling off the low frequency response below 100 cycles, restoring it to constant velocity. As a result, less than 15 db of low frequency boost was needed, simplifying preamplifier design, and this amount was not exceeded as the frequency was lowered, enabling inferior turntables to be used without excessive hum and rumble problems. Doubtless this characteristic was adopted to accelerate the acceptance of LP's by the public. The high frequency pre-emphasis was 16 db at 10 kc, which resulted in a low hiss level when the corresponding de-emphasis was used in the playback amplifier.

For a short time, most of the American record industry employed this characteristic. Eventually, however, improved techniques and the quest for better sound has led to changes. For low distortion recording of extreme bass, it was desirable to continue the 6 db/octave low frequency slope to the lower limits of audibility, or at least to 20 or 30 cycles. Improved record materials reduced the need for large amounts of pre-emphasis of high frequencies. In addition, the industry became cognizant of the large amounts of distortion which could be introduced be pre-emphasis. The playback stylus simply cannot follow the sudden changes in direction of a groove recorded at high amplitude and a high frequency. The problem of pinch effect and plastic deformation of the record material are related to this, and all are greatly exaggerated by high frequency pre-emphasis.

As a result, in 1950 the AES playback curve was introduced by the Audio Engineering Society. The low frequency turnover point was 400 cycles and the boost was defined down to 30 cycles instead of the 50 cycles lower limit of the earlier Columbia and NAB curves. High frequency roll-off was 12 db at 10 kc.

Many independent record companies adopted this curve, and it shared the field with the Columbia LP curve until 1952 when the RCA new Orthophonic records were announced. This characteristic came the long awaited industry standard, known as the RIAA characteristic.

Fig. 1 shows three of the most common recording equalization characteristics. Virtually every LP record made in this country was recorded with one of these characteristics. The dotted lines are drawn with 6 db/octave slopes, starting at the appropriate turnover or roll-off frequencies. In practise, the curves are rounded, with the response at the inflection point 3 db removed from the reference level (solid lines). This is somewhat modified by interaction between the High and Low frequency equalization.

These curves, as we have previously pointed out, also show the output of a magnetic pickup when playing a record cut with the corresponding characteristic. In order to obtain flat frequency response, the playback preamplifier must have a response inverse to the recording characteristic, i.e. a boost of the lows and roll-off of the highs.

Continued on page 7

FAIRCHILD 280 AND 281 TONE ARMS

One of the lowest priced and most versatile high quality arms is the Fairchild 280 (and its 16" counterpart, the 281). Priced at $29.50 net, it is competitive with the Pickering 190D and GE A1-500 arms.

A discussion of some of the criteria involved in tone arm design is planned for a future issue of the REPORT. At that time we will try to compare the various arms from several standpoints. For the present, we are offering our appraisal of the Fairchild arms alone, based on our personal experience with both 280 and 281 models.

The 280 arm is formed of an extruded aluminum tube of square cross section. This is light and strong, and is claimed to be free from torsional resonances. A counterweight at the rear of the arm enables it to be balanced around the vertical axis. This is highly desirable, in our opinion, since it makes the levelling of the turntable and arm much less critical than if an unbalanced arm were used. The horizontal pivot is well back from the stylus, near the vertical pivot. The vertical mass (the mass which must be moved by a stylus riding on a warped record, for instance) is kept reasonably low by virtue of the fact that stylus pressure is controlled by a spring rather than a counterweight, so that the only mass free to move vertically is the cartridge plus the aluminum tubing of the arm.

The 280 arm has several novel features, although in some details an excellent conception is marred by a design flaw. For example, the bearings, both vertical and horizontal, are pivot type instrument bearings. The pivots are inserted in cups drilled in the ends of screws, which are not sturdy enough to withstand very much side thrust. This is particularly true in the case of the vertical pivots, since when sliding the cartridge drawer in or out, a considerable side thrust may be applied to the pivots unless the arm is held securely. One of our pivot screws broke before we became aware of this problem. It is possible, however, that ours had a defective screw and this may not be a general fault.

Another nice feature is the built-in detent. Once the arm is correctly mounted, swinging it off to one side will engage the detent and hold the arm in place ('though not securely enough to permit safe movement of the motorboard). Here again, a manufacturing flaw has partially negated an excellent idea. The detent consists of a piece of spring metal attached to the arm, which snaps over a roll pin passing through the vertical support column. The roll pin is easily bent by rough handling. Furthermore, the arm proper is fastened to the vertical support column only by means of a frictional contact between a splined shaft and the column. The column is a piece of soft aluminum tubing, and a careless downward pressure on the arm can slide it down from its proper position. Once dislodged, it is difficult if not impossible to make it stay in the correct position. Our 281 arm was delivered in this condition.

The arm may be levelled by means of the three mounting screws. This is a simple operation, 'though not as ingenious, perhaps, as Pickering's single hole mounting. Adjustments are provided for arm height (to accommodate any standard turntable up to 3" high), stylus height (to prevent the stylus striking the turntable if no record is on it), and stylus pressure. One of the nicest features of the 280 and 281 arms is the plug-in cartridge drawer. Virtually any standard cartridge (including the GE triple-play) can be mounted in the drawers (available separately at $1.85 each) which slide in and out of the end of the arm quite easily. Electrical connections are made automatically with any type of cartridge by wiping spring contacts, which short as the drawer is removed, to prevent audible noises during a change of cartridge. When a GE triple play cartridge is used, the knob is removed, the cartridge inserted, and the knob replaced thru a snap-out cover on the arm.

We found a simple method of minimizing the hazards of damaging bearings or risking a floppy detent (such as can happen if the roll pin bends). A short post can be mounted on the motorboard, with a dial lock mounted on its top so as to engage and hold the finger left when the arm is in the rest position. In this way the front of the arm is securely clamped when the plug-in drawer is removed or inserted, and all the side thrust is removed from the vertical bearings. We suggest either the National type ODL or Bud type DL-1947 dial lock.

From the foregoing discussion, one might gather the impression that we take a dim view of the Fairchild arms. Nothing could be further from the truth. Several members of our staff (including the writer) use them in their own systems, and employ them in custom installations. From the standpoint of performance, appearance, cost and flexibility, they are of the first rank. Like many other precision devices, they must be handled carefully, and when so handled should give long and satisfactory service. It is not unlikely that the faults we have noted will be corrected by the manufacturer who is undoubtedly aware of them.

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COMING SOON.....

All ready for this issue was a report on the much publicized Pilotone AA-903 amplifier which had to be omitted because of space considerations. We have also completed tests on the Scott 310 FM tuner and the National Criterion tuner, and promise to include these as well as the AA-903 in next month's REPORT.

Also available as space will allow are reports on several phono cartridges, the National Horizon 5 preamplifier, and the Pilot FM-607 tuner. Planned for early release are the National Horizon 10 and 20 watt amplifiers, Fisher FM-80 tuner, Craftsmen C-800 and C-900 tuners, and others too numerous to mention.

The most welcome news to many of you will be that we are obtaining a Karlson 15" enclosure and plan to give it top priority in our speaker testing program. More of you have asked about the Karlson than about any other single item, and we're not a little curious ourselves. Watch for further developments.

JH

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SORRY WE'RE LATE . . . .

-but pressure of business and personal matters have put a crimp in our publication schedule this month. We'll try to catch up at least to the extent of getting out each issue during the month it is scheduled for, but please don't get worried if your Report comes a bit late. For one thing, we have found the mails to be very slow and each month a dozen or so readers fail to get their copy at all. If it doesn't arrive by the middle of the following month, drop us a card and we'll have another go at it.

FISHER 70RT TUNER - AUDIO SECTION

Last month we discussed the performance of the FM tuner section of the Fisher 70RT FM-AM tuner. The audio section of this unit was tested in the manner prescribed for preamplifiers in the November, 1954 issue of The Audio League Report.

Initially, the tone controls were set for flattest response. This did not coincide with center positions of the bass and treble knobs. The bass control was set at "2:00 o'clock" and the treble control at "10:30 o'clock".

On the TV input, 0.21 volts input produced 1.0 volts output at maximum gain. Hum and noise were 70 db below 2 volts output at any setting of the volume control (Fisher claims -86 db). On the phono input (ORTHO equalization), 5.5 mv input produced 1 volt output, and hum and noise were -53 db relative to 2 volts output (Fisher claims -62 db). In the FM position of the function selector switch, with the limiters removed, the hum and noise were -68 db at maximum volume, -77 db at minimum volume, both relative to 2 volts output. This is indicative of the residual hum on FM listening, assuming no hum is introduced by modulation of the oscillator in the tuner. All the hum levels measured on this set were satisfactorily low and in keeping with the current state of the art as it applies to commercial equipment, even if not quite up to advertised claims.

The maximum output, without visible distortion, was 5 volts, and actual clipping did not occur until 15-20 volts output. 5 volts is more than adequate to drive any commercial power amplifier.

With the test signal applied to the TV input, and the loudness compensation disabled (a front panel switch is provided for this), the tone control extremes and flattest position were measured. These are plotted in Fig. 1. Fisher's claim of ±15 db variations at 50 cycles and 10 kc is quite accurate. However, the overall level is raised about 6 db at center frequencies if full boost is used at both ends. This much variation in level is not desirable, though as far as we are concerned, neither is a 15 db boost at either end, to say nothing of both! In the flattest position, response is ±3 db from 20-20000 cycles. Fisher claims ±1 db over this range - an attainable figure even with their tone control circuits but not easy to maintain in production with commercial component tolerances.

Figure 2 shows the phono equalization error on the AES, ORTHO, and LP positions. An NARTB position is also provided, which appears to combine the low frequency equalization of AES with the high frequency response of LP.

In general, the phono equalization is excellent. Even the old AES characteristic, which calls for a considerable low frequency boost to equalize it "all the way down" is adequately handled to below 30 cycles.

The loudness control was checked out with the volume 1/3 up ("10:00 o'clock) as recommended by the manufacturer. The test signal was fed into the TV input, and response was measured from 20 to 20,000 cycles. The measured response is shown in Fig. 3.

In practice, we found that with any but the poorest speaker systems, this loudness control gave an unnatural boomy quality which was most unpleasant to listen to. Several people of our acquaintance who use the 70 RT have had the same reaction and therefore keep the loudness compensation switched off. On a system with poor bass response, some improvement is noticeable at low levels.

The shape of the response curve of the loudness compensator reveals its weakness. This same characteristic is typical of the Centralab "Compentrol" whose circuit is quite similar to Fisher's. In the writer's opinion, only the IRC control is capable of reasonable non-boomy loudness compensation - and even it is not acceptable to many listeners. A comparison of the Fisher loudness curve with the IRC is presented in Fig. 3. Both controls were adjusted to reduce the mid-frequency level by 40 db from its maximum value. In the region from 60 cycles to 1000 cycles, the Fisher provides much more boost than the IRC. The additional 3-6 db boost of the Fisher control in the 100-300 cycle region is responsible for the boomy quality. On

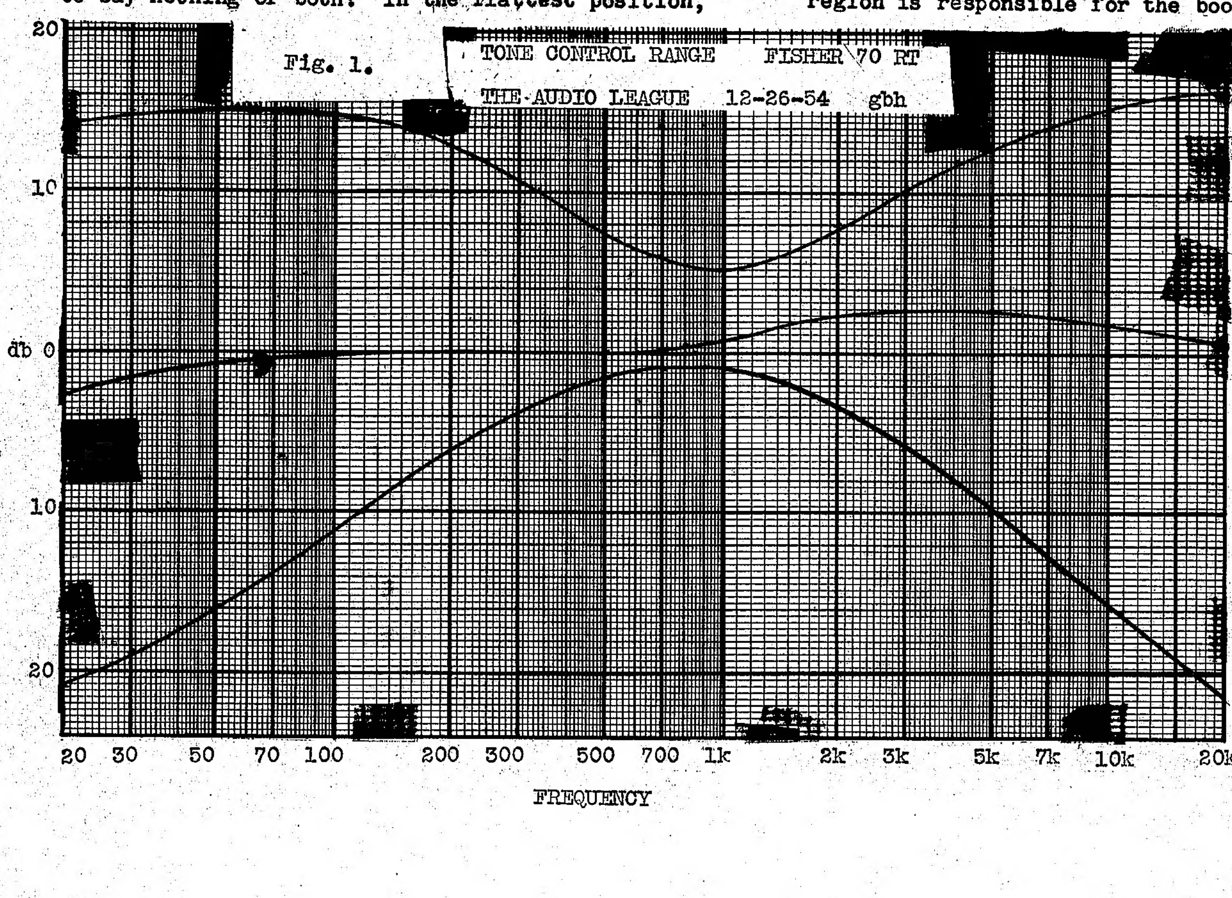
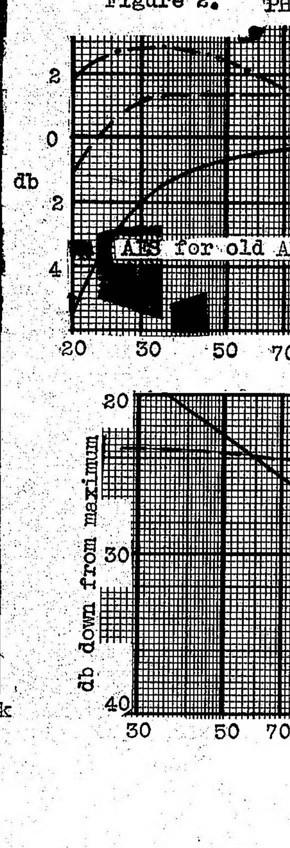


Figure 2.



the other hand, the IRC boost continues to rise at a 6 db/octave rate as one goes below 60 cycles, giving considerable enhancement to the production of extreme low frequencies at low levels. There is also more high frequency boost in the IRC circuit which some may find objectionable (the writer finds his quite pleasing). The subject of loudness controls is a controversial one, and will be treated more fully in a future issue of the REPORT.

When the outstanding FM tuner performance of the 70 RT is considered as well, we do not hesitate to recommend this unit to anyone who does not demand the superior flexibility of a separate preamplifier, or would like to reduce interconnecting wiring to a minimum.

JH

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REPORT ON FISHER Z-MATIC

Last fall the Fisher Radio Corporation announced what they somewhat immodestly termed the "greatest advance in amplifier design in twenty years" - Z-matic. They claimed that it

(1) multiplied the efficiency and effective audible range of any speaker system, regardless of size;

(2) could be set by the user according to his personal taste on requirements of his speaker system;

(3) eliminated need for oversize speaker enclosures and automatically corrects inherent deficiencies in speaker or speaker housing;

(4) Z-matic was not to be confused with tone controls or loudness controls.

Z-matic was made a standard feature of their 70-A and 50-A amplifiers at no extra cost, and a modification kit was made available to owners of earlier 70-A and 50-A amplifiers at a cost of $2.50 to enable them to add Z-matic to their systems.

Having previously tested a 70-A (see Vol. 1, No. 1 for our report on this amplifier), we purchased a modification kit and installed it on the amplifier we had tested. The installation instructions were quite complete, although the pictorial wiring diagram was a little confusing due to showing more terminals than were actually available on one of the terminal strips. Anyone capable of using a soldering iron, pliers and drill (a few holes must be drilled in the chassis also), should have no difficulty installing Z-matic in 15 minutes or so.

We had heard a brief demonstration of Z-matic at the New York Audio Fair, but not enough to convince us that it really accomplished anything desirable. At the time we were assured that it was not a positive current feedback circuit, such as used by Bogen. Examination of the circuit showed that it indeed was not -- rather it could be considered a bridge circuit in which negative voltage feedback could be combined with negative current feedback in any desired proportion by means of the control provided. The impedance of the speaker voice coil forms one arm of the bridge, and under balanced conditions, (when the speaker impedance is actually 16 ohms or 8 ohms), there is only voltage feedback of approximately the same amount as in the original amplifier circuit. When the speaker impedance rises, as at resonancé or at high frequencies, the bridge becomes unbalanced and introduces negative current feedback. See Fig. 1 for the schematic.

Negative voltage feedback has the effect of reducing the internal impedance of an amplifier, so that the output voltage will be relatively independent of load impedance. On the other hand, negative current feedback increases the internal impedance, tending to keep the output current constant with load variations. In other words, increasing the load impedance will result in increasing output voltage if current feedback is present, and in little or no change in output voltage if voltage feedback is present. By suitably proportioning the current and voltage feedback, it should be possible to obtain an output characteristic which will allow enough rise in output voltage with

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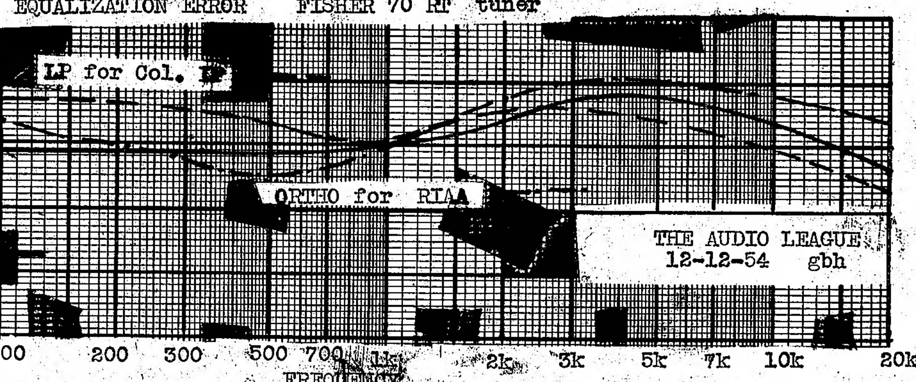
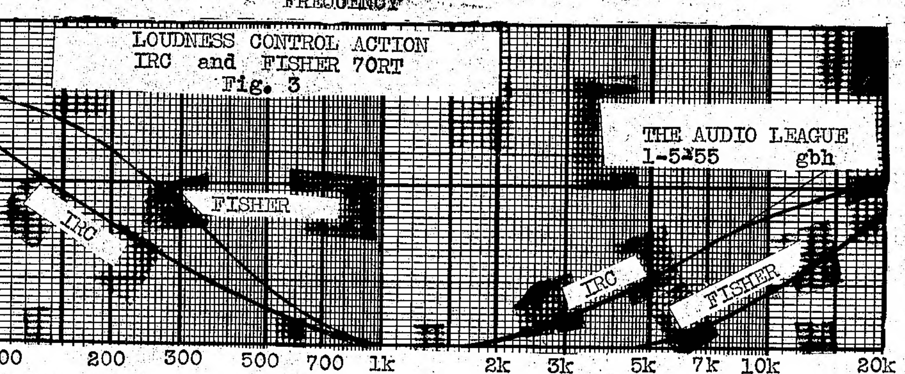
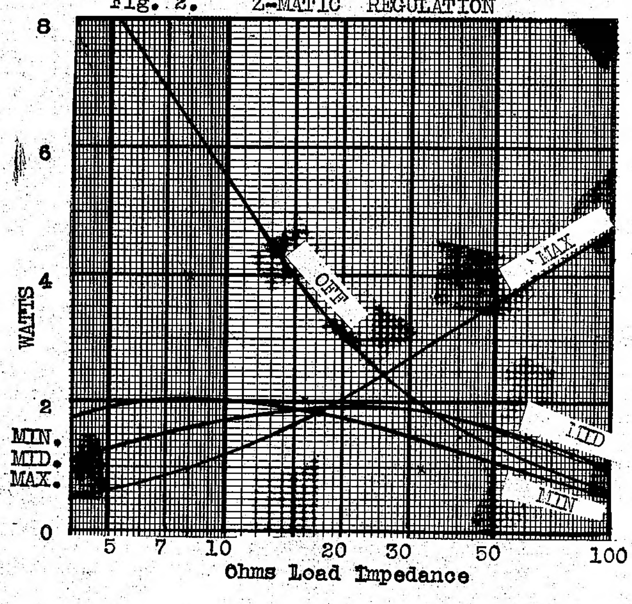
EQUALIZATION ERROR FISHER 70 RT tuner





FREQUENCY

Fig. 2. Z-MATIC REGULATION



Z-Matic Continued from page 5
increasing impedance so that constant power will be delivered to the load. It is our supposition that this is the purpose of Z-matic.

There is nothing new about this idea, incidentally -- the Stan White "Powrtron" amplifiers have been doing this for over a year, 'though without the features of adjustment and optional use which Z-matic provides. Emory Cook's "ultimate amplifier" offers a similar feature, 'though it is specifically trimmed for a certain output transformer and speaker load.

As we understand the philosophy behind constant power amplifiers, it is argued that, at a speaker's resonance, its impedance rises to many times its nominal value. A constant voltage source will thus deliver much less power to the speaker at resonance, since the power is inversely proportional to load resistance. This, it is claimed, can give thin bass on certain speaker systems when driven from an amplifier having very low internal impedance, or high damping factor, which is another way of saying the same thing. Thus it is argued that an amplifier should deliver constant power to the speaker rather than constant voltage, thereby maintaining response at the bass resonance (or any other).

It seems to us that this neglects a couple of significant factors. First, the efficiency of a speaker system rises at resonance, so the reduction in power delivered to the speaker is largely offset by the increased efficiency. This can be proven any time by feeding an oscillator into a heavily damped amplifier and speaker system and listening to the acoustic output as the frequency is swept through resonance. On every system we've tried this on, there has been an audible rise in output at resonance. It would seem that a constant power amplifier would overcompensate and give excessive bass response. Secondly, below the bass resonance, speaker impedance falls rapidly, and a constant power amplifier will actually deliver less power than a constant voltage amplifier in this region, where we usually try to squeeze out every last cycle of response. All of this assumes, of course, that the speaker is not being overdriven.

Earlier sad experiences with related schemes for improving damping have left us extremely skeptical of such approaches to the improvement of reproduced sound. Therefore we did not continue fruitlessly attempting to predict Z-matic's performance on paper, but proceeded to our laboratory and listening tests.

After the modification was made, we checked out the amplifier frequency and power response, gain, hum level, etc. in the same manner as our original measurements. There were no apparent changes, except for a slight reduction in gain, which we suppose to be due to tolerances in the feedback resistors.

We then adjusted the input signal for an output of approximately 4 watts into a 16-ohm load resistor at 400 cycles and did not change it for the duration of the tests. The load resistance was varied from 4 ohms to infinity (open circuit) and the power delivered to the load was plotted as a function of load resistance. This was initially done with the Z-matic control switched OFF, which essentially restores the amplifier to its original condition by shorting the current feedback resistor. As one would expect from an amplifier with considerable voltage feedback, the power dropped sharply as the load impedance increased. See Fig. 2.

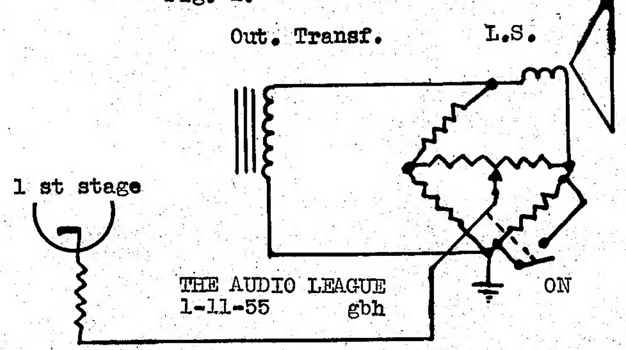
The Z-matic was then switched ON, but left in its minimum position and the above test repeated. Similarly, data was taken at a mid-setting of the control, and with maximum "Z-matic".

The "MAX" curve shows, as we have stated earlier, that a large amount of current feedback produces a condition where power rises as load impedance is increased in contrast to the OFF characteristic. At the MIN setting, a considerable degree of compensation is observable, 'though output power still falls off somewhat with increasing load. At the MID position, we have a close approach to the "constant-power" amplifier. Over a load range of 6 to 70 ohms (on the 16-ohm output of the amplifier) the output power is constant within ±1.5 db, as compared to a ±9 db change with only voltage feedback in use. Note the 6 db drop in amplifier gain when Z-matic was switched ON. Presumably this is due to the addition of the negative current feedback which has the same effect on gain as the negative voltage feedback.

The above curves are not, in any way, dependent on frequency, since the same results were obtainable anywhere in the 20-20,000 cycle region.

We did find one point in which original amplifier performance was degraded. The amplifier would oscillate at a high frequency if the load resistance exceeded a few hundred ohms when the Z-matic switch was either OFF or in the MIN position. This condition disappeared at high Z-matic settings. Such impedance would not ordinarily be encountered in practice, but this does indicate a reduction in the safety margin of the amplifier feedback circuits. Subsequent deterioration of tubes or changing component values might very well cause the amplifier to oscillate at a super-audible frequency, especially under transient conditions. Such a condition could give a subtle degradation to sound and yet be very difficult to pin down and correct.

Fig. 1. SCHEMATIC OF Z-MATIC



Also, the amplifier exhibited a low frequency "bounce" when using Z-matic. Any transient signal would set up a damped oscillation which might last a second or more.

Apart from this, the circuit appeared to do everything one could expect from it. We therefore connected the amplifier to our air coupler (see Dec. 1954 issue) and swept the oscillator frequency from 100 cycles down to 30 cycles with Z-matic switched OFF. Between 40-50 cycles, the sound virtually disappeared at low levels. With Z-matic ON there was audible output from the air coupler all the way down. Apparently the impedance of the speaker took a rise in the 40-50 cycle region, and the Z-matic, true to claims, pumped more power into it and let us hear something. Unfortunately, our air coupler can't put out much in the 40-50 cycle region, so we were hearing mostly second harmonic distortion. But it kept the sound from disappearing, anyway.

We listened to various test records with this set-up, but could hear no difference whatever with or without Z-matic. Since our crossover network was only feeding 120 cycles and below through

Continued on Page 8.

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Fig.2 shows the equalization error incurred by playing a record cut with the LP or AES characteristic on an RIAA-equalized system. A study of these curves will show that the RIAA curve is within ±2 or 3 db of either the LP or AES curves down to 100 cycles (maybe lower?). For this reason, a playback system with RIAA equalization will do a very acceptable job of reproducing either LP or AES records. It usually takes a practised ear or an A-B comparison to detect any difference between the RIAA and either of the other curves on playback.

In view of the small differences between recording characteristics, it seems a trifle absurd to design preamplifiers with from 6 to 16 or more possible equalization characteristics.

One prominent manufacturer has written us as follows: "...I hope that you will take a crack at all the various record curves. Some of them differ so slightly that the average ear cannot hear them. Room factors and many other factors in recording have a much greater effect on the frequency response as heard than the difference between one record curve and another, and yet we are required to put a lot of switching in for this. I feel that this extra switching is just wasting the customer's money".

We find outselves in complete agreement with this gentleman, whose excellent preamplifier has a considerable number of different record equalization characteristics. After all, the customer must be given what he wants, even if he doesn't need it. This is as true in the sale of hi-fi components as in the sale of automobiles or soap.

GLOSSARY OF TERMS

AES - Audio Engineering Society

Constant Amplitude - a condition in which the lateral movements of the recording stylus is independent of frequency. The velocity of the stylus is then directly proportion to frequency.

Constant Velocity - a condition in which the maximum lateral velocity of the recording stylus is independent of frequency. The amplitude is then inversely proportional to frequency.

Inflection-Point - the frequency at which the slope of the recording characteristic changes; usually a transition from constant amplitude to constant velocity or vice versa.

NARTB - National Association of Radio & TV Broadcasters.

Octave - a 2:1 range of frequencies

RIAA - Record Industry Association of America.

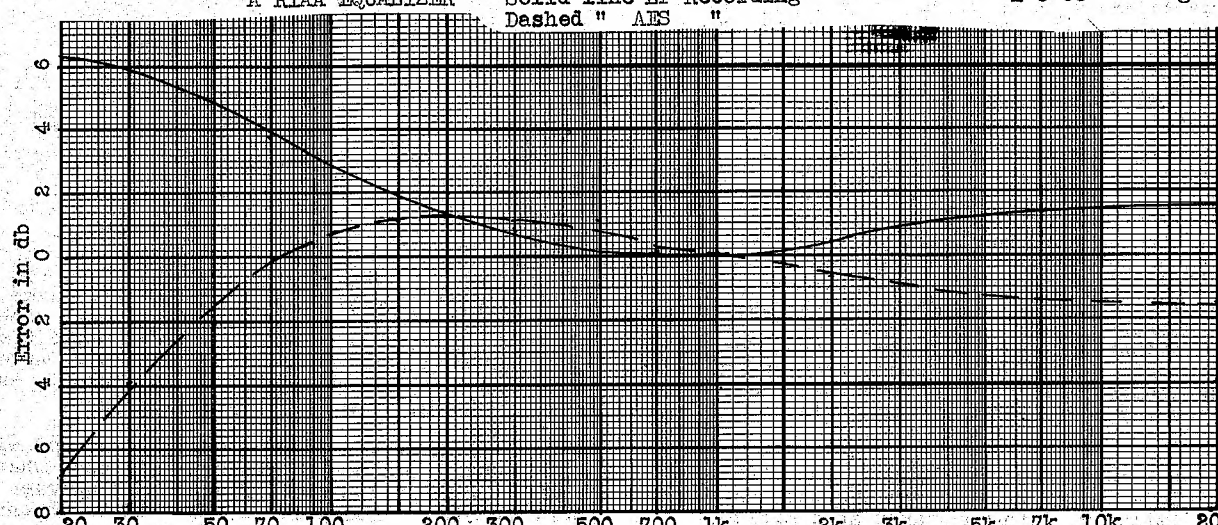
A TABULATION OF RECORDING CHARACTERISTICS

Name	Turnover L.F.	H.F. Transition	Remarks
AES	400	2.5 kc	Old standard
Bartok	629	2.8 kc (7.5 db/oct)	
Columbia	500	1.59 kc	(LP) Levels off below 100 cps
Columbia 78	300	1.59 kc	
EMI	250	flat to 10kc	
ffrr 78	250	3 kc (3 db/oct)	
London '51-'53	400	2.12 kc (4.5 db/oct)	to 10 kc, then rolls off
London 1953	450	3 kc	levels off below 100 cps
NAB '49	500	1.59 kc	levels off below 80 cps
Orthocoustic	500	1.5 kc (3 db/oct)	levels off below 80 cps
Orthophonic (See RIAA)			
RCA '38-'52	600	2.12 kc to 6 kc	slight change in 1947
RIAA (also called Orthophonic, New AES, NARTB)	500	2.12 - 6kc	levels off below50cps

By defining the transition points and the level off points, it is possible to reconstruct any of these curves within close tolerances. Those using slopes other than a standard 6 db per octave (20 db per decade) are indicated by a number in ( ). The most used curves are the RIAA, AES and LP. These curves are drawn on Fig. 1. All Audio League tests will consider these three curves. These curves are drawn to show both the asymptotes and the actual curves.

Fig. 2. EQUALIZATION ERROR FOR AES & LP PLAYBACK ON A RIAA EQUALIZER Solid line LP Recording Dashed " AES "

THE AUDIO LEAGUE 1-5-55 gbh



Z-Matic Continued from Page 6

the Fisher and air coupler, this was not much of a test. Therefore, the amplifier was returned to its owner and re-installed in his system. His speaker system is a home-built Klipsch Rebel, heavily reinforced, with an Electrovoice 15W woofer, E-V T25 and 8HD mid-range squawker, and University 4401 tweeter, with crossovers at 800 and 5000 cycles. This system is very pleasant sounding and well-balanced, and we have picked up clean 30-cycle output from it with our sound level meter at 90-100 db levels.

At first there seemed to be a subtle smoothing of the highs when Z-matic was switched ON. After extended listening, however, the owner of the system found that he couldn't tolerate the Z-matic, and kept it switched OFF.

We spent an evening at his home, trying it for ourselves, with live FM broadcasts and records for program material. The effect of merely switching Z-matic ON was most apparent and startling. It can best be likened to hanging a blanket over the speaker opening. Highs were muffled, and a general haziness came over the music. The loss of highs is easily explained, since the University 4401 tweeter has about 12 ohms impedance and thus receives less power than it would from a constant voltage source. However, a little treble boost restored the highs, but not the clarity. It's a little hard to explain, but we just couldn't leave the Z-matic ON and still enjoy the music. It got worse as the control was advanced, but not much. Most of the damage seemed to have been done by introducing even a moderate amount of current feedback.

Frankly, we don't have a good explanation of the effects we observed. Our experience is not unique, however, since we have received a letter from one of our readers who installed a Z-matic kit in his 70-A. He comments on a "metallic ringing" when switching off his system or operating other switches (probably the low frequency bounce we observed). He also writes, "...no definite improvement aurally, generally results are poorer than before installation".

What is the verdict on Z-matic, then? We have not found any audible improvement and, in general, an unpleasant muddying of sound when using Z-matic. It surely enables one to select constant voltage, constant power, or approximately constant current operation of one amplifier equipped with it, for whatever that feature may be worth.

Current Fisher amplifiers are equipped with Z-matic, but you can always switch it out, so don't let that keep you from getting an otherwise fine amplifier if you are so inclined. If you have an earlier model, save your $2.50 and leave it alone. "Greatest advance in amplifier design in twenty years"? We doubt it.

JM

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